FIGURE 1

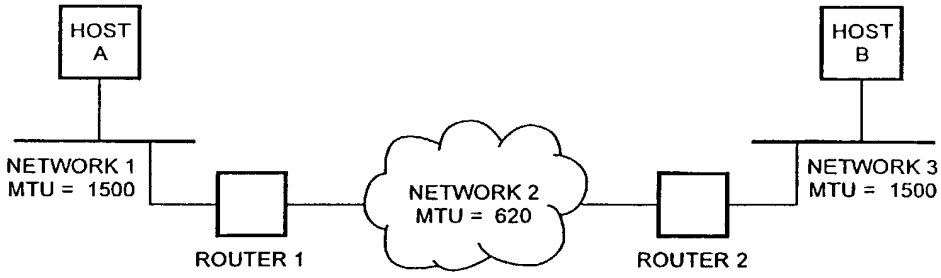

HOST
A
HOST
B
NETWORK 1
MTU = 1500
NETWORK 2
MTU = 620
NETWORK 3
MTU = 1500
ROUTER 1
ROUTER 2

FIGURE 2

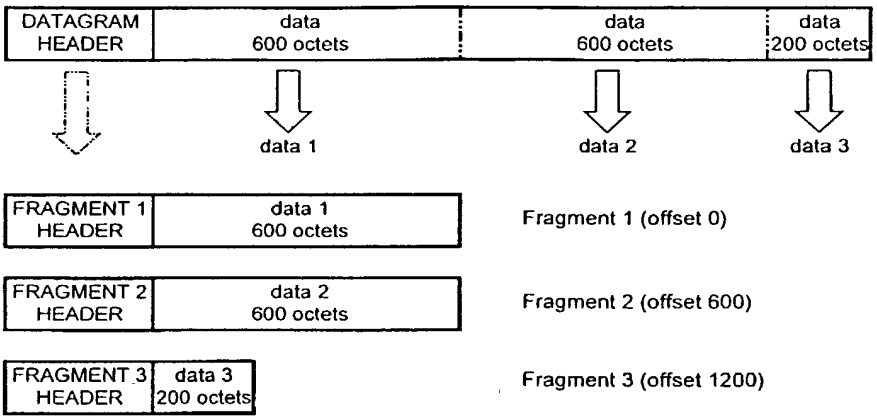

DATAGRAM HEADER
data 600 octets
data 600 octets
data 200 octets
data 1
data 2
data 3
FRAGMENT 1 HEADER
data 1 600 octets
Fragment 1 (offset 0)
FRAGMENT 2 HEADER
data 2 600 octets
Fragment 2 (offset 600)
FRAGMENT 3 HEADER
data 3 200 octets
Fragment 3 (offset 1200)

FIGURE 3

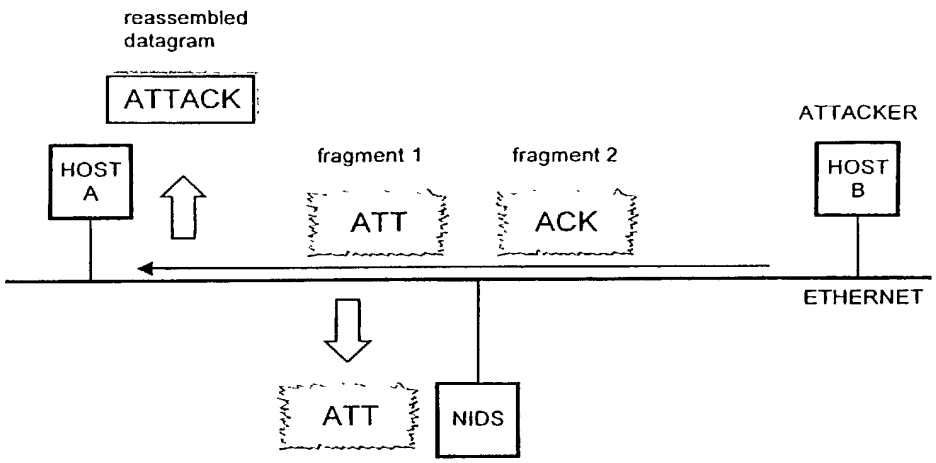

reassembled
datagram
ATTACK
HOST
A
fragment 1
fragment 2
ATT
ACK
ATTACKER
HOST
B
ETHERNET
ATT
NIDS

FIGURE 4

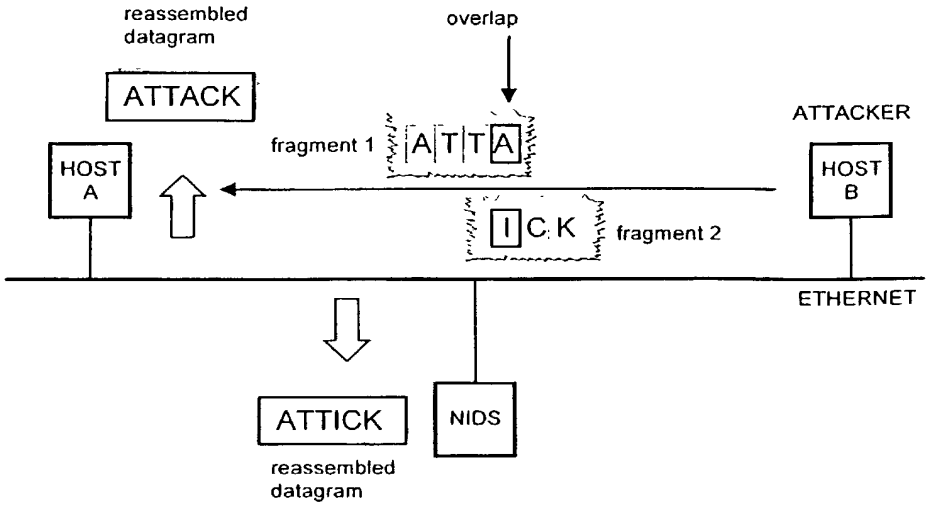

reassembled
datagram
overlap
ATTACK
ATTACKER
fragment 1
A T T A
HOST
A
HOST
B
I C K
fragment 2
ETHERNET
ATTICK
NIDS
reassembled
datagram

FIGURE 5

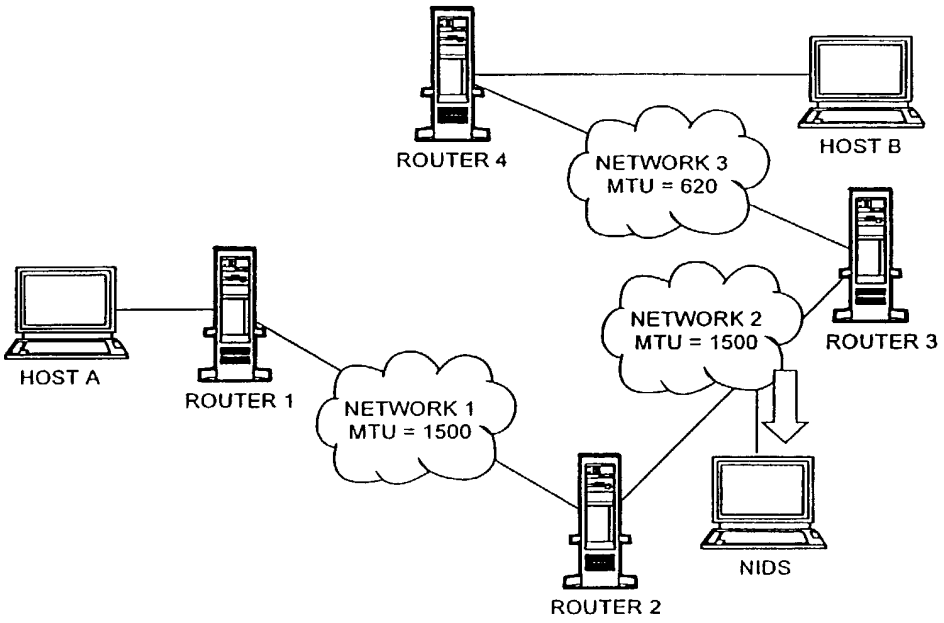

ROUTER 4
HOST B
NETWORK 3
MTU = 620
ROUTER 3
NETWORK 2
MTU = 1500
HOST A
ROUTER 1
NETWORK 1
MTU = 1500
NIDS
ROUTER 2

FIGURE 6

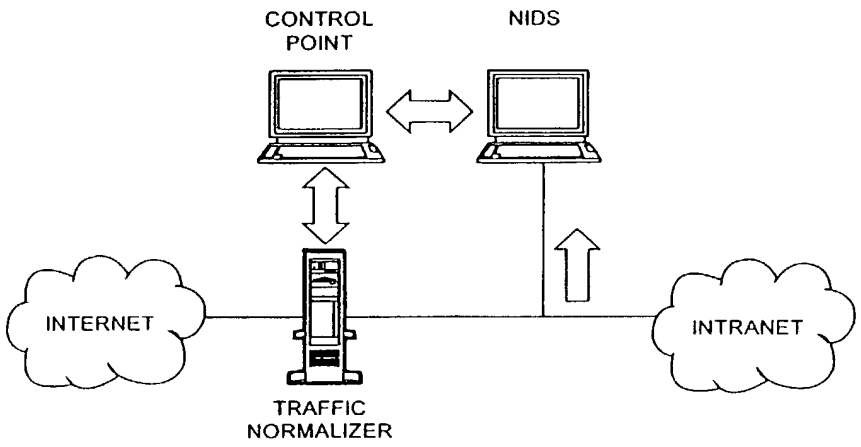


FIGURE 7

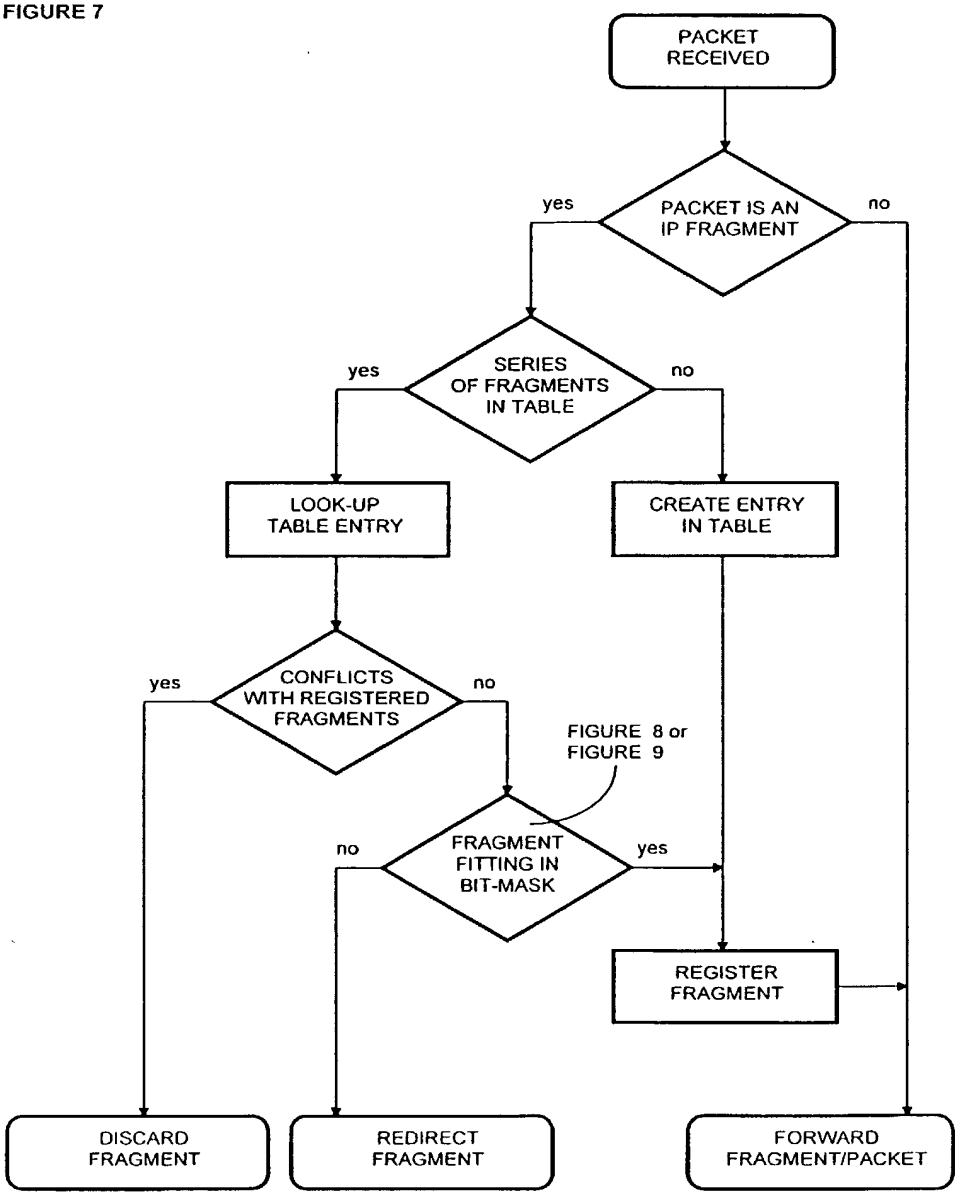

PACKET RECEIVED
PACKET IS AN IP FRAGMENT
yes
no
SERIES OF FRAGMENTS IN TABLE
yes
no
LOOK-UP TABLE ENTRY
CREATE ENTRY IN TABLE
CONFLICTS WITH REGISTERED FRAGMENTS
yes
no
FIGURE 8 or FIGURE 9
FRAGMENT FITTING IN BIT-MASK
no
yes
REGISTER FRAGMENT
DISCARD FRAGMENT
REDIRECT FRAGMENT
FORWARD FRAGMENT/PACKET

FIGURE 8

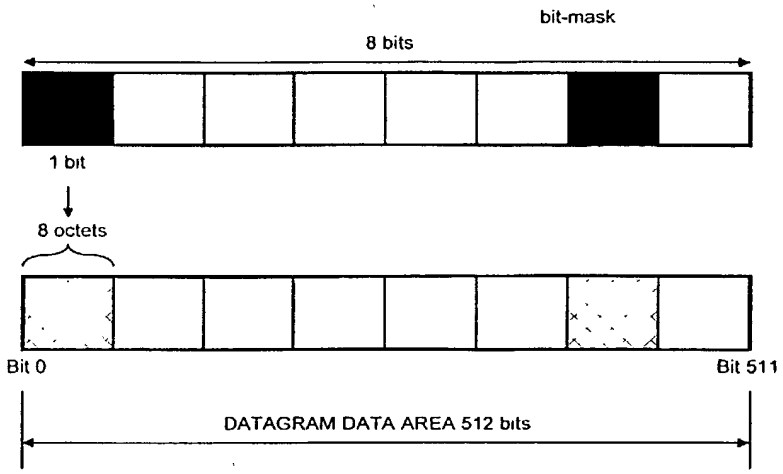

bit-mask
8 bits
1 bit
8 octets
Bit 0
Bit 511
DATAGRAM DATA AREA 512 bits

FIGURE 9

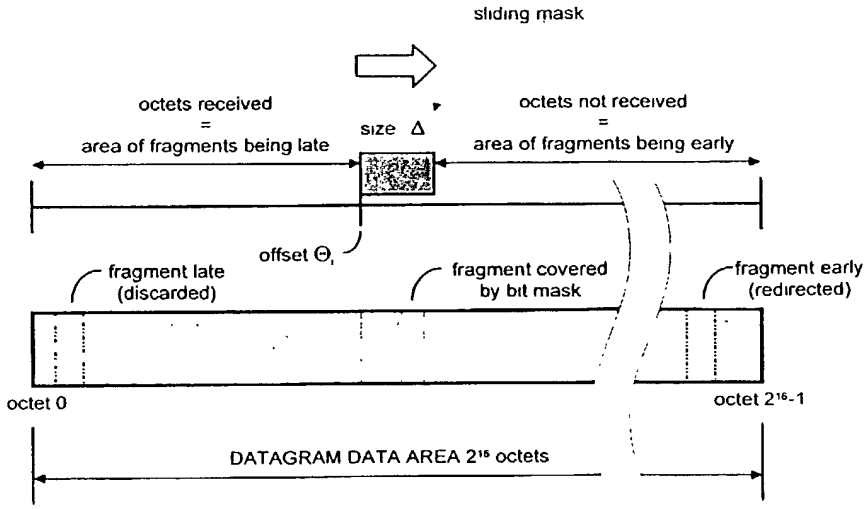

sliding mask
octets received
=
area of fragments being late
size Δ
octets not received
=
area of fragments being early
offset Θi
fragment late
(discarded)
fragment covered
by bit mask
fragment early
(redirected)
octet 0
octet 2¹⁶-1
DATAGRAM DATA AREA 2¹⁶ octets

FIGURE 10

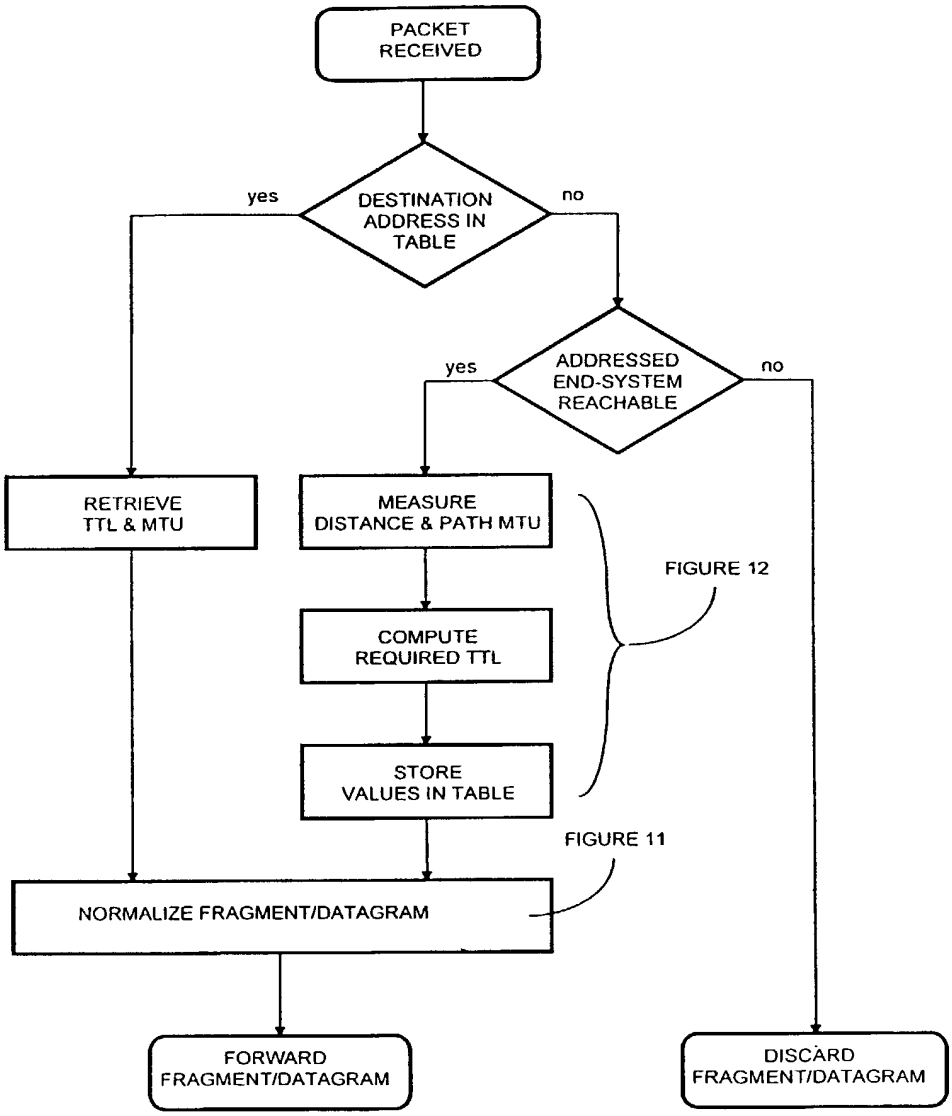

PACKET RECEIVED
DESTINATION ADDRESS IN TABLE
yes
no
ADDRESSED END-SYSTEM REACHABLE
yes
no
RETRIEVE TTL & MTU
MEASURE DISTANCE & PATH MTU
COMPUTE REQUIRED TTL
STORE VALUES IN TABLE
FIGURE 12
FIGURE 11
NORMALIZE FRAGMENT/DATAGRAM
FORWARD FRAGMENT/DATAGRAM
DISCARD FRAGMENT/DATAGRAM

FIGURE 11

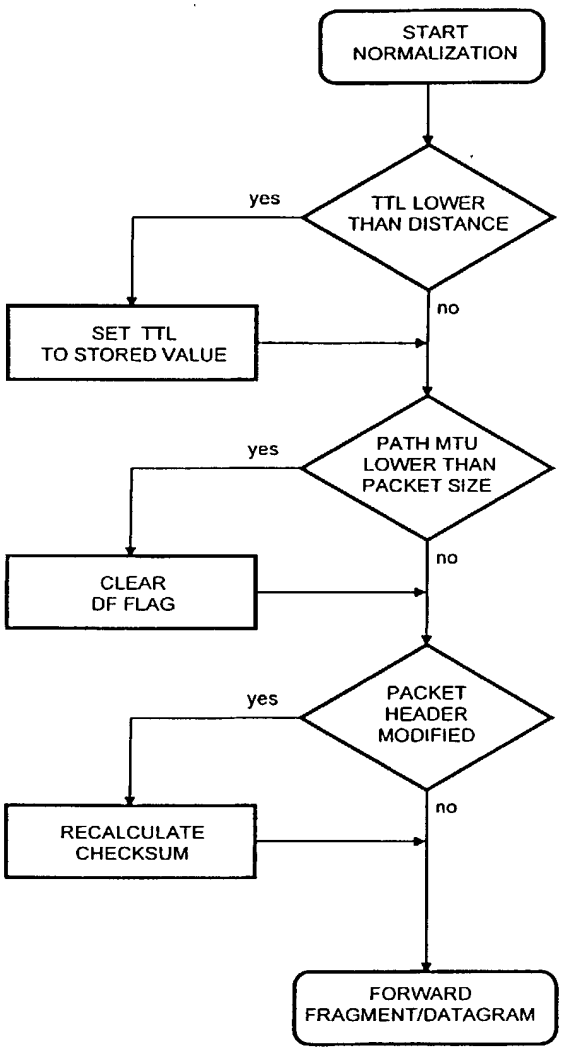

START NORMALIZATION
TTL LOWER THAN DISTANCE
yes
no
SET TTL TO STORED VALUE
PATH MTU LOWER THAN PACKET SIZE
yes
no
CLEAR DF FLAG
PACKET HEADER MODIFIED
yes
no
RECALCULATE CHECKSUM
FORWARD FRAGMENT/DATAGRAM

FIGURE 12

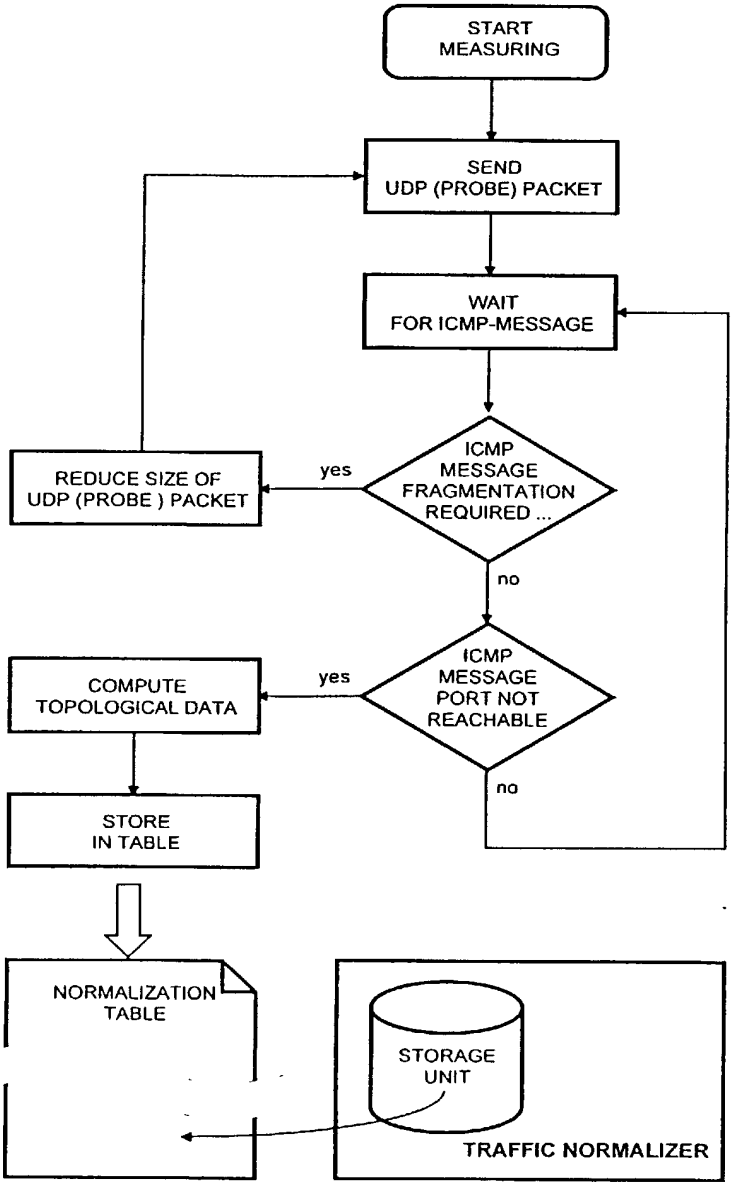

START MEASURING
SEND UDP (PROBE) PACKET
WAIT FOR ICMP-MESSAGE
ICMP MESSAGE FRAGMENTATION REQUIRED ...
yes
REDUCE SIZE OF UDP (PROBE ) PACKET
no
ICMP MESSAGE PORT NOT REACHABLE
yes
COMPUTE TOPOLOGICAL DATA
no
STORE IN TABLE
NORMALIZATION TABLE
STORAGE UNIT
TRAFFIC NORMALIZER

FIGURE 13

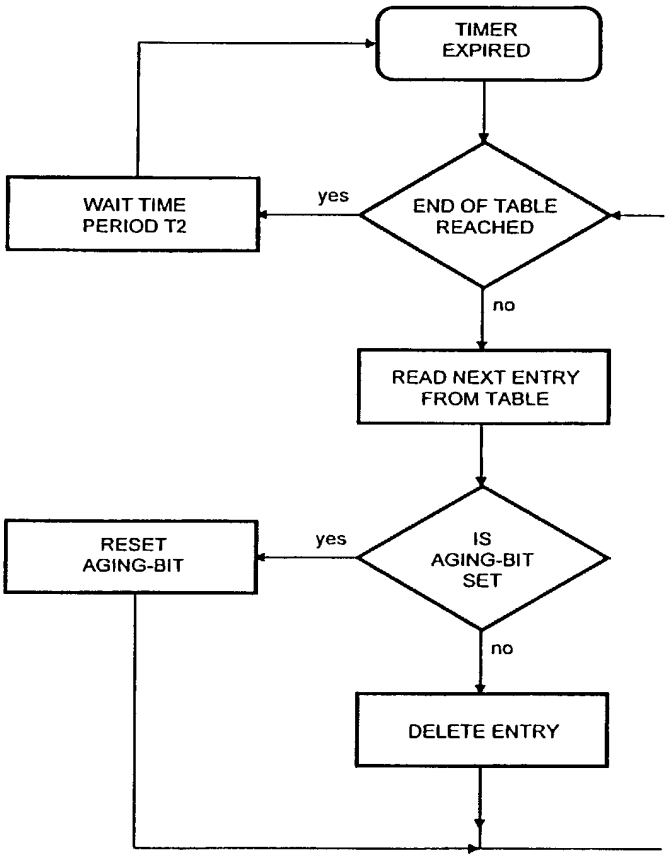
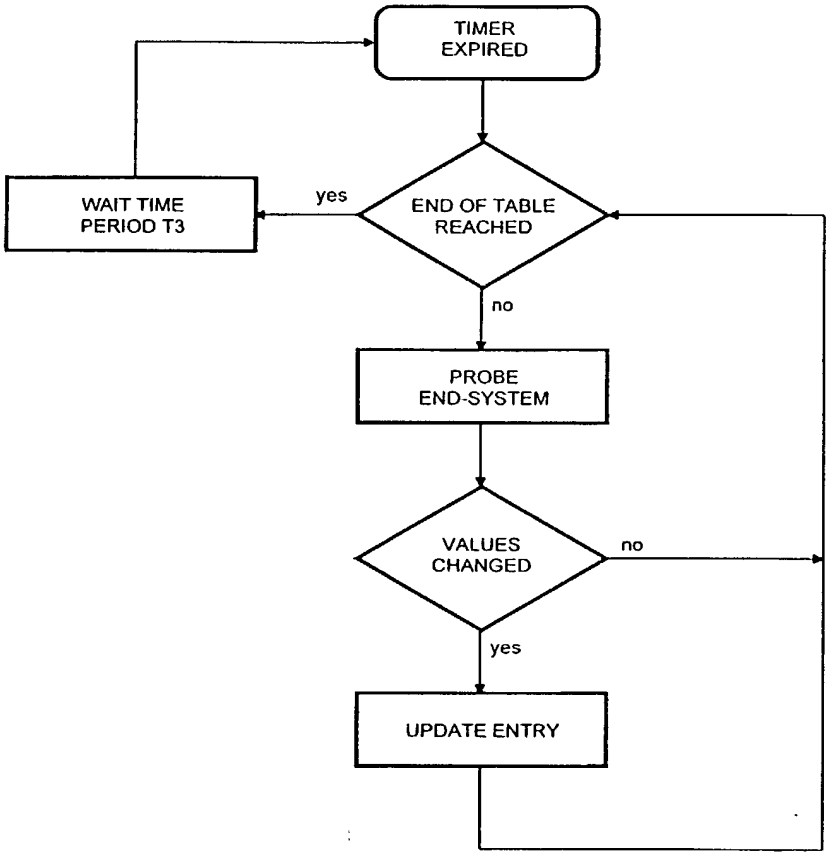

TIMER EXPIRED
END OF TABLE REACHED
yes
WAIT TIME PERIOD T2
no
READ NEXT ENTRY FROM TABLE
IS AGING-BIT SET
yes
RESET AGING-BIT
no
DELETE ENTRY

FIGURE 14


TIMER EXPIRED
END OF TABLE REACHED
yes
WAIT TIME PERIOD T3
no
PROBE END-SYSTEM
VALUES CHANGED
no
yes
UPDATE ENTRY